

SUPPLEMENTARY MATERIALS

Supplemental Methods

Models for survey participation and censoring were specified separately. Each person-visit was treated as an observation in the models which included time-fixed and time-varying variables. Our model of survey participation included variables collected at time of census (age, gender and community of residence) whereas the censoring model included demographic and sexual behavioral variables collected at census and time of survey. The denominator of the weights was a logistic regression model for the probability of contributing person-time which was defined as the joint probability of participating in the survey and of being observed at the following survey. The numerator was the joint probability of the marginal distributions for participation and censoring. Weighted incidence rate ratios were estimated using Poisson regression assuming independence between individual participant observations conditional on observed covariates.¹⁶

Supplementary Table 1. Characteristics of men and women migrating into RCCS study communities, 1999-2016.

	Women (N= 3055)	Men (N= 1396)
Reasons for migrating		
Newly married/new consensual	1122 (36.7%)	24 (2%)
Work	616 (20.2%)	633 (45%)
Started new household	179 (5.9%)	410 (29%)
Living with relatives/friends	1140 (36.3%)	250 (18%)
Other reasons ¹	28 (0.9%)	79 (6%)
Place of Origin		
Rakai District	2033 (67%)	795 (57%)
<i>Kabira</i>	138 (9%)	57 (9.0%)
<i>Kakuuto</i>	211 (14%)	93 (15%)
<i>Kalisizo</i>	182 (12%)	55 (9%)
<i>Kasasa</i>	163 (10%)	69 (11%)
<i>Kitumba</i>	113 (7%)	59 (9%)
<i>Kyanamukaaka</i>	84 (5%)	32 (5%)
<i>Kyebe</i>	76 (5%)	29 (5%)
<i>Kyotera</i>	334 (21%)	126 (20%)
<i>Lwanda</i>	216 (14%)	93 (15%)
<i>Elsewhere in Rakai</i>	516 (17%)	182 (13%)
Lyantonde	51 (3%)	20 (3%)
Masaka District	177 (6%)	82 (6%)
Kampala	180 (6%)	132(10%)
Elsewhere in Uganda	290 (10%)	136 (10%)
Outside Uganda	41 (1%)	17 (1%)
Unknown	220 (7%)	181 (13%)
Missing	63 (2%)	33 (2%)
Distance from place of origin		
0-5 km	643 (21%)	309 (22%)
5-15 km	836 (27%)	276 (20%)
15-30 km	603 (20%)	222 (16%)
30-90 km	455 (15%)	238 (16%)
90-180 km	261 (9%)	122 (9%)
>180 km	257 (8%)	239 (17%)

Data are number (%). Some percentages do not add up to 100 because of rounding.

¹Other reasons include: Divorced/Separated, Education, Polygamous man travelling between household

Supplementary Table 2: Crude and adjusted HIV incidence rate ratios by time since migration and among long-term residents in men and women in the RCCS, 1999-2015

Resident status	No of events/ py* at risk	Incidence rate per 100 py (95% CI)	Crude IRR (95% CI)	Demographics only adjIRR (95% CI)	Demographics+sexual behaviors adjIRR (95% CI)
Women (N=8,326)					
Permanent residents	315/33730	0.93 (0.84, 1.04)	Ref.	Ref.	Ref.
In-migrant (time since arrival)					
0-1 year	9/407	2.21 (1.15, 4.25)	2.35(1.22, 4.52)	2.00 (1.03, 3.90)	1.11 (0.30, 4.07)
1-2 years	61/3239	1.88 (1.42, 2.42)	2.00 (1.53, 2.62)	1.72 (1.28, 2.31)	2.53 (1.72, 3.71)
2-3 years	21/1956	1.07 (0.70, 1.64)	1.14 (0.74, 1.77)	1.02 (0.65, 1.60)	1.46 (0.80, 2.65)
3-4 years	20/2094	0.95 (0.62, 1.48)	1.02 (0.65, 1.59)	0.92 (0.59, 1.45)	1.09 (0.57, 2.11)
4-5 years	10/1341	0.74 (0.40, 1.39)	0.80 (0.43, 1.49)	0.76 (0.41, 1.44)	0.85 (0.30, 2.38)
> 5 years	51/6312	0.81 (0.61, 1.06)	0.87 (0.65, 1.16)	0.95 (0.70, 1.29)	0.78 (0.47, 1.30)
Men (N= 6,861)					
Permanent residents	283/33849	0.84 (0.74, 0.94)	Ref.	Ref.	Ref.
In-migrant (time since arrival)					
0-1 year	2/107	1.87 (0.47, 7.49)	2.24 (0.57, 8.82)	2.24 (0.55, 9.10)	3.44 (0.82, 14.4)
1-2 years	19/1278	1.49 (0.95, 2.33)	1.78 (1.13, 2.82)	1.69 (1.07, 2.69)	1.77 (1.02, 3.07)
2-3 years	10/895	1.12 (0.60, 2.08)	1.34 (0.71, 2.50)	1.26 (0.67, 2.36)	1.81 (0.95, 3.43)
3-4 years	7/850	0.82 (0.39, 1.73)	0.99 (0.47, 2.09)	0.97 (0.45, 2.05)	0.80 (0.29, 2.17)
4-5 years	6/661	0.91 (0.41, 2.02)	1.09 (0.48, 2.43)	1.19 (0.53, 2.65)	1.11 (0.41, 3.03)
> 5 years	27/2574	1.05 (0.72, 1.53)	1.25 (0.84, 1.86)	1.44 (0.96, 2.17)	1.21 (0.67, 2.20)
Women and Men (N=15,187)					
Permanent residents	598/67579	0.88(0.82, 0.96)	Ref.	Ref.	Ref.
In-migrant (time since arrival)					
0-1 year	11/514	2.14 (1.18, 3.86)	2.41 (1.34, 4.34)	2.04 (1.12, 3.70)	1.64 (0.64, 4.21)
1-2 years	80/4517	1.77 (1.42, 2.20)	2.00 (1.58, 2.51)	1.73 (1.36, 2.21)	2.16 (1.59, 2.93)
2-3 years	31/2851	1.09 (0.76, 1.55)	1.23 (0.86, 1.75)	1.10 (0.76, 1.58)	1.52 (0.98, 2.37)
3-4 years	27/2943	0.92 (0.63, 1.34)	1.03 (0.70, 1.52)	0.92 (0.63, 1.36)	0.94 (0.55, 1.61)
4-5 years	16/2001	0.80 (0.49, 1.30)	0.90 (0.55, 1.48)	0.85 (0.52, 1.40)	0.91 (0.44, 1.86)
> 5 years	78/8887	0.88 (0.70, 1.09)	0.99 (0.78, 1.26)	1.04 (0.81, 1.33)	0.88 (0.60, 1.31)

IRR=incidence rate ratio; adjIRR=adjusted incidence rate ratio. * person-years; Model adjusted for demographics included the following variables in addition to migration history exposure: age in years, marital status, education, religion, time period, occupation and male circumcision; Models adjusted for sexual behaviors also included sex with partner residing outside community in the past year, number of different sexual partners in the past year, number of lifetime sexual partner, number of non-marital partners, consistent condom use with non-marital partner and alcohol use with sex; Bolded estimates are statistically significant at $p > 0.05$

Supplementary Table 3. Crude and adjusted incidence rate ratios of HIV acquisition by recent and non-recent migrants, and residents using inverse probability survey weights

Resident Status	Crude IRR (95% CI)	IPW Demographics only adjIRR (95% CI)	IPW Demographics+sexual behaviors adjIRR (95% CI)
Women (N=8,326)			
Permanent residents	Ref.	Ref.	Ref.
In-migrants (time since arrival)			
0-2 years	3.03 (2.12, 4.34)	2.36 (1.61, 3.47)	2.31 (1.58, 3.37)
> 2 years	1.18(0.79, 1.58)	1.02(0.71, 1.46)	0.96 (0.67, 1.39)
Men (N= 6,861)			
Permanent residents	Ref.	Ref.	Ref.
In-migrants (time since arrival)			
0-2 years	1.83 (1.08, 3.10)	1.78 (1.04, 3.04)	1.72 (1.00, 2.93)
> 2 years	1.36 (0.92, 2.02)	1.24 (0.82, 1.87)	1.25 (0.83, 1.89)
Women and Men (N=15,187)			
Permanent residents	Ref.	Ref.	Ref.
In-migrants (time since arrival)			
0-2 years	2.67 (1.99, 3.57)	2.04 (1.50, 2.77)	1.99 (1.46, 2.69)
> 2 years	1.30 (1.00, 1.68)	1.03 (0.77, 1.36)	1.02 (0.77, 1.35)

IPW=Inverse probability weighted; IRR=incidence rate ratio; adjIRR=adjusted incidence rate ratio. *person-years; Model adjusted for demographics included the following variables in addition to migration history exposure: age in years, marital status, education, religion, calendar period, occupation and male circumcision; Models adjusted for sexual behaviors also included sex with partner residing outside community in the past year, number of different sexual partners in the past year, number of lifetime sexual partner, number of non-marital partners, consistent condom use with non-marital partner and alcohol use with sex; Bolded estimates are statistically significant at $p > 0.05$

Supplementary Table 4. Age-stratified crude and adjusted incidence rate ratios of HIV acquisition by recent and non-recent migrant status and long-term residents, among women and men in the RCCS, 1999-2015

Resident status	Women (N=8,326)			Men (N=6,861)		
	Incidence rate/100 pys	Crude IRR (95% CI)	Demographics only adjIRR (95% CI)	Incidence rate/100 pys	Crude IRR (95% CI)	Demographics only adjIRR (95% CI)
15-24 years						
Permanent residents	1.41 (1.17, 1.70)	Ref.	Ref.	0.66 (0.52, 0.85)	Ref.	Ref.
In-migrants (time since arrival)						
0-2 years	1.42 (0.99, 2.03)	1.00 (0.68, 1.50)	1.09 (0.71, 1.68)	1.21 (0.54, 2.70)	1.82 (0.79, 4.18)	1.42 (0.59, 3.41)
> 2 years	0.93 (0.64, 1.34)	0.65 (0.43, 0.99)	0.60 (0.44, 1.09)	1.05 (0.54, 2.01)	1.57 (0.78, 3.15)	1.21 (0.59, 2.47)
25-34 years						
Permanent residents	0.95 (0.80, 1.14)	Ref.	Ref.	1.20 (1.03, 1.41)	Ref.	Ref.
In-migrants (time since arrival)						
0-2 years	2.75 (1.95, 3.87)	2.88 (1.97, 4.19)	2.78 (1.91, 4.06)	1.80 (0.99, 3.24)	1.49 (0.82, 2.73)	1.54 (0.85, 2.82)
> 2 years	0.84 (0.65, 1.10)	0.88 (0.64, 1.21)	1.02 (0.74, 1.42)	1.08 (0.74, 1.58)	0.90 (0.60, 1.35)	1.05 (0.69, 1.59)
35 years and older						
Permanent residents	0.60 (0.48, 0.76)	Ref.	Ref.	0.55 (0.43, 0.71)	Ref.	Ref.
In-migrants (time since arrival)						
0-2 years	2.05 (0.98, 4.31)	3.40 (1.59, 7.27)	3.19 (1.46, 7.00)	1.44 (0.54, 3.84)	2.61 (0.96, 7.06)	2.82 (1.03, 7.69)
> 2 years	0.87 (0.56, 1.35)	1.44 (0.88, 2.35)	1.70 (1.02, 2.84)	0.86 (0.51, 1.46)	1.56 (0.88, 2.77)	1.93 (1.07, 3.50)

IRR=incidence rate ratio; adjIRR=adjusted incidence rate ratio. *person-years; Model adjusted for demographics included the following variables in addition to migration history exposure: age in years, marital status, education, religion, calendar period, occupation and male circumcision; Models adjusted for sexual behaviors also included sex with partner residing outside community in the past year, number of different sexual partners in the past year, number of lifetime sexual partner, number of non-marital partners, consistent condom use with non-marital partner and alcohol use with sex; Bolded estimates are statistically significant at $p > 0.05$

Supplementary Table 5: HIV incidence and crude and adjusted IRR by recent and non-recent migration and resident status by CHP calendar period among women and men in the RCCS, 1999-2015.

CHP scale-up period	Women (N=8,326)			Men (N=6,861)		
	No of events/py* at risk	Incidence/100 py (95% CI)	Demographics only adjIRR (95%CI)	No of events/py at risk	Incidence/100 py (95% CI)	Demographics only adjIRR (95% CI)
Pre-CHP (1999-2004)						
Permanent residents**	106/10003	1.06 (0.87, 1.28)	Ref.	94/8285.59	1.13 (0.93, 1.39)	Ref.
In-migrants (time since arrival)						
0-2 years	22/1163	1.89 (1.24, 2.87)	1.63 (1.01, 2.62)	6/475.05	1.26 (0.57, 2.81)	1.17 (0.52, 2.64)
> 2 years	15/1359	1.10 (0.66, 1.83)	0.92 (0.54, 1.57)	9/610.73	1.47 (0.76, 2.83)	1.29 (0.66, 2.54)
Early-CHP (2005-2011)						
Permanent residents	154/15005	1.02 (0.88, 1.20)	Ref.	138/15634.42	0.88 (0.75, 1.04)	Ref.
In-migrants (time since arrival)						
0-2 years	33/1636	2.01 (1.43, 2.84)	1.76 (1.16, 2.67)	9/509.45	1.77 (0.92, 3.39)	1.96 (0.99, 3.89)
> 2 years	54/5584	0.97 (0.74, 1.26)	0.92 (0.66, 1.27)	30/2427.45	1.23 (0.86, 1.77)	1.41 (0.94, 2.12)
Late-CHP (2011-2015)						
Permanent residents	55/8722	0.63 (0.48, 0.82)	Ref.	51/9928.92	0.51 (0.39, 0.67)	Ref.
In-migrants (time since arrival)						
0-2 years	15/848	1.77 (1.07, 2.93)	2.15 (1.15, 4.00)	6/399.74	1.50 (0.67, 3.34)	2.47 (1.06, 5.75)
> 2 years	33/4760	0.69 (0.49, 0.97)	1.12 (0.69, 1.79)	11/1940.98	0.57 (0.31, 1.02)	1.16 (0.60, 2.22)

adjIRR=adjusted incidence rate ratio, * person-years; ** no migration history. Model adjusted for demographics included the following variables in addition to migration history exposure: age in years, marital status, education, occupation, religion and male circumcision

Supplementary Table 6: Crude HIV incidence rates among in-migrant men and women in the RCCS by reason for migrating, place of origin, and distance from place of origin.

Migration information	Women	Men
	Incidence Rate/100 py (95% CI)	Incidence Rate/100 py (95% CI)
Reasons for migrating		
Newly Married/New consensual relation	1.06 (0.83, 1.35)	2.20 (0.71, 6.82)
Work	1.15 (0.83, 1.59)	0.98 (0.68, 1.42)
Started new household	2.04 (1.31, 3.16)	0.92 (0.60, 1.42)
Living with Relative/friend	0.94 (0.73, 1.26)	1.41 (0.87, 2.31)
Other Reasons ¹	.	0.74 (0.24, 2.30)
Place of origin		
Rakai District	1.04 (0.85, 1.28)	1.09 (0.79, 1.49)
Masaka District	1.60 (0.93, 2.75)	1.17 (0.55, 2.83)
Elsewhere in Rakai	1.37 (0.98, 1.93)	1.10 (0.52, 2.20)
Kampala	1.57 (0.87, 2.83)	1.05 (0.44, 2.53)
Elsewhere in Uganda	0.60 (0.31, 1.16)	1.24 (0.59, 2.61)
Outside Uganda	0.49 (0.07, 3.45)	-
Unknown	0.80 (0.43, 1.49)	0.58 (0.24, 1.40)
Distance from place of origin		
0,5 kilometers	1.07 (0.78, 1.47)	1.50 (1.02, 2.20)
5,15 kilometers	1.00 (0.75, 1.33)	0.96 (0.57, 1.62)
15,30 kilometers	1.05 (0.75, 1.47)	0.79 (0.39, 1.58)
30,90 kilometers	1.36 (0.94, 1.97)	1.03 (0.55, 1.92)
90,180 kilometers	1.48 (0.92, 2.38)	1.07 (0.48, 2.39)
Greater than 180 kilometers	0.82 (0.45, 1.48)	0.67(0.32, 1.40)

¹Other reasons include: Divorced/Separated, Education, Polygamous man travelling between household